## CLAIMS

I claim:

1. A method for downward extrapolation of pre-stack seismic data, comprising:
selecting a set of prestack seismic data;
determining a migration interval in the seismic data set;
selecting a maximum error criterion for the migration interval;
calculating a maximum relative error in phase as a function of frequency, propagation angle, and the relative variation in velocity in the migration interval;
comparing the maximum relative error in phase to the maximum error criterion; and
determining the type of extrapolation to use in the migration interval from the comparison of the maximum relative error in phase to the maximum error criterion.

2. The method of claim 1, wherein the type of extrapolation is selected from a set comprising Gazdag phase-shift extrapolation, split-shift Fourier extrapolation, and implicit finite difference extrapolation.

3. The method of claim 1, wherein the step of calculating a maximum relative error in phase comprises:
selecting a frequency $\omega$ in the migration interval;
identifying a maximum wavenumber $k_{max}$ in the migration interval;
identifying a minimum velocity $c_{min}$ in the migration interval;
determining a maximum propagation angle $\theta_{max}$ in the migration interval, using the frequency $\omega$, the maximum wavenumber $k_{max}$, and the minimum velocity $c_{min}$;
selecting a reference velocity $c_0$ in the migration interval;
calculating a maximum relative error in phase $\Delta\Phi_{max}$, using the maximum propagation angle $\theta_{max}$ and the reference velocity $c_0$.

4. The method of claim 3, wherein the maximum wavenumber $k_{max}$ is identified to include 95% of the power within a circle of radius $k=k_{max}$.

5. The method of claim 3, wherein the minimum velocity $c_{min}$ is identified by scanning the velocity slice for the next migration step to identify a minimum velocity value.

6. The method of claim 3, wherein the maximum propagation angle $\theta_{max}$ is determined by the equation:

$$\theta_{\max} = \sin^{-1}\left(\frac{k_{\max} \cdot c_{\min}}{\omega}\right),$$

where $k_{max}$ is the maximum wavenumber, $c_{min}$ is the minimum velocity, and $\omega$ is the frequency.

7. The method of claim 3, wherein the reference velocity $c_0$ is determined by the equation:

$$c_0 = \frac{c_{\min}}{\sin(\theta_{\max})},$$

where $c_{min}$ is the minimum velocity and $\theta_{max}$ is the maximum propagation angle.

8. The method of claim 3, wherein the maximum relative error in phase $\Delta\Phi_{max}$ for split-step Fourier extrapolation is determined using the equation:

$$\frac{\Delta\Phi}{\Phi(c(x,y))} = \left(\frac{\omega\Delta z}{c_0}\right)\cdot\left[\sqrt{\left(\frac{c(x,y)}{c_0}\right)^2 - \sin^2(\theta)} + \left(1 - \cos(\theta) - \frac{c(x,y)}{c_0}\right)\right],$$

where $\Phi$ is phase, $\Delta\Phi$ is phase error over the migration interval, $\theta$ is the propagation angle with respect to the vertical, $c(x,y)$ is the velocity, and $c_0$ is the reference velocity.